



Johannes Locke



Johannes Locke

E L E M E N T S

O F

Natural Philosophy.

By JOHN LOCKE, Esquire.



To which are added,

S O M E T H O U G H T S

C O N C E R N I N G

R E A D I N G A N D S T U D Y

F O R A G E N T L E M A N .

BY THE SAME AUTHOR.

L O N D O N ,

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An account of the following tracts by Monsieur des Maizeaux, being part of a dedication prefixed to these and some other pieces of Mr. Locke's, when they were first published in the year 1720.

THESE *Elements of Natural Philosophy*, Mr. Locke had composed, or rather dictated for the use of a young gentleman, whose education he had very much at heart. It is an abstract or summary of whatever is most material in natural philosophy; which Mr. Locke did afterwards explain more at large to that young gentleman. The same is practised in the universities, where, you know, it is cu-

stomary for the professors to dictate such abridgements, to serve for the subject and rule of their lectures. And therefore this small tract is far from being what Mr. Locke would have made it, had he written upon that matter professedly, and designed to make it a complete work.

However, as the generality of men expect every thing should be perfect that proceed from such a writer as Mr. Locke, and do not enter into the occasions or designs which he proposed to himself in writing; I own that some persons, very good judges, whom I have taken the liberty to con-

sult about the impression of some pieces in this collection, were of opinion that this little treatise had better been left out, for fear every reader should not make the proper allowances, and least the memory of Mr. Locke should suffer by it. I yielded to their opinion; and was resolved to lay that piece aside. But being informed that there were several other copies of it abroad, which it was impossible to suppress, or hinder from falling, one time or other, into the hands of the printers, maimed and disfigured, as is too often the case on such occasions, I was obliged to take o-

ther measures: and I the more easily determined to publish it, because I could give it more complete, more correct, and in better order, than can possibly be pretended to by the copies above-mentioned.

After all I may take upon me to say, that, in its kind, this piece is no way to be despised. We wanted such a work in English: and it would not have been an easy matter to find any other person who could have comprehended so many things in so few words, and in so clear and distinct a manner. Great use may be made of it in the instruction

of young gentlemen, as it was originally designed by Mr. Locke. And persons even of riper years may improve by it: either by recalling ideas that had slipped out of their memory; or by informing themselves of several things, that were unknown to them.

To this treatise are subjoined, *some thoughts concerning reading and study for a gentleman.* Mr. Locke having one day in conversation discoursed upon the method that a young gentleman should take in his reading and study; one of the company was so well pleased with it, that he desired him to dictate to him the

substance of what he had been speaking: which Mr Locke immediately did. This is one of the usual conversations of Mr. Locke, reduced into writing: from whence you may judge, Sir, how agreeable and advantageous it was to converse with that great man.

Mr Locke not only points out the sciences that a gentleman ought to study, whether as a private man, or one in a public capacity; but likewise directs to such books as treat of those sciences, and which in his opinion are the properest for that end. As you have acquired, Sir, in I-

raly, the most refined taste for
 the politer arts, and have added
 that study to those Mr. Locke
 here recommends to a gentle-
 man ; you will perhaps wonder
 that he says nothing of painting,
 sculpture, architecture, and o-
 ther arts of this kind, which
 make an accomplish'd gentleman.
 But I desire you would consider,
 that there are but few persons in
 possession of the means necessary
 for attaining this sort of know-
 ledge ; and that Mr. Locke is
 speaking here of what may suit
 the circumstances of the genera-
 lity of people. Besides, he was
 very far from imagining that an

extemporary advice, which he was giving by his fire-side would ever be exposed to common view. However, I presume to think, that after you have perused it, you will be of opinion it was not unworthy to be made public.

ELEMENTS

OF

Natural Philosophy.

CHAP. I.

OF MATTER AND MOTION.

MATTER is an extended solid substance; which being comprehended under distinct surfaces, makes so many particular distinct bodies.

Motion is so well known by the sight and touch, that to use words to give a clearer idea of it, would be in vain.

Matter, or body, is indifferent to motion, or rest.

There is as much force required to put a body, which is in motion, at rest; as there is to set a body, which is at rest, into motion.

No parcel of matter can give itself either motion or rest; and therefore a body at rest will remain so eternally, except some external cause puts it in motion; and a body in motion will move eternally, unless some external cause stops it.

A body in motion will always move on in a strait line, unless it be turned out of it by some external cause; because a body can no more alter the determination of its motion, than it can begin it, alter or stop its motion itself.

The swiftness of motion, is measured by distance of place, and length of time where, in it is performed. For instance, if A and B, bodies of equal or different bigness, move each of them an inch in the same time; their motions are equally swift: but if A moves two inches in the time whilst B is moving one inch; the motion of A is twice as swift as that of B.

The quantity of motion, is measured by the swiftness of the motion, and the quan-

NATURAL PHILOSOPHY. 3

ity of the matter moved, taken together. For instance, if A, a body equal to B, moves as swift as B; then it hath an equal quantity of motion. If A hath twice as much matter as B, and moves equally as swift; it hath double the quantity of motion; and so in proportion.

It appears, as far as human observation reaches, to be a settled law of nature, that "all bodies have a tendency, attraction, or gravitation towards one another."

The same force applied to two different bodies, produces always the same quantity of motion in each of them. For instance, let a boat, which with its loading is one tun, be tied at a distance, to another vessel, which with its loading is twenty-six tuns; if the rope that ties them together be pulled, either in the less or bigger of these vessels, the less of the two, in their approach one to another, will move twenty-six foot, while the other moves but one foot.

Wherefore the quantity of matter in the

earth being twenty-six times more, than in the moon; the motion in the moon towards the earth, by the common force of attraction, by which they are impelled towards one another, will be twenty-six times as fast as in the earth; that is, the moon will move twenty-six miles towards the earth, for every mile the earth moves towards the moon.

Hence it is, that in this natural tendency of bodies towards one another, that in the lesser is considered as gravitation; and that in the bigger as attraction: because the motion of the lesser body (by reason of its much greater swiftness) is alone taken notice of.

This attraction is the strongest, the nearer the attracting bodies are to each other; and in different distances of the same bodies, is reciprocally in the duplicate proportion of those distances. For instance, if two bodies, at a given distance, attract each other with a certain force, at half the di-

NATURAL PHILOSOPHY. 5

stance, they will attract each other with four times that force; at one third of the distance, with nine times that force; and so on.

Two bodies at a distance, will put one another into motion by the force of attraction; which is unexplicable by us, though made evident to us by experience, and so to be taken as a principle in natural philosophy.

Supposing then the earth the sole body in the universe, and at rest; if God should create the moon, at the same distance that it is now from the earth; the earth, and the moon would presently begin to move one towards another in a strait line by this motion of attraction or gravitation.

If a body, that by the attraction of another would move in a strait line towards it, receives a new motion any ways oblique to the first; it will no longer move in a strait line, according to either of those directions; but in a curve, that will partake of both: and this curve will differ, according to the

6 ELEMENTS OF

nature and quantity of the forces that concurred to produce it: as, for instance, in many cases it will be such a curve as ends where it begun, or recurs into itself; that is, makes up a circle, or an ellipsis or oval very little differing from a circle.

CHAP. II. OF THE UNIVERSE.

TO any one, who looks about him in the world, there are obvious several distinct masses of matter, separate from one another; some whereof have discernable motions. These are the sun, the fixt stars, the comets, and the planets, amongst which this earth, which we inhabit, is one. All these are visible to our naked eyes.

Besides these, telescopes have discovered several fixt stars, invisible to the naked eye; and several other bodies moving about some of the planets; all which were invisible and

NATURAL PHILOSOPHY. 7

unknown, before the use of prospective glasses were found.

The vast distances between these great bodies, are called intermundane spaces; in which tho' there may be some fluid matter, yet it is so thin and subtle; and there is so little of that in respect of the great masses that move in those spaces, that it is as much as nothing.

These masses of matter are, either luminous, or opaque, or dark.

Luminous bodies, are such as give light of themselves; and such are the sun, and the fixt stars.

Dark or opaque bodies, are such as emit no light of themselves, though they are capable of reflecting of it, when it is cast-upon them from other bodies; and such are the planets.

There are some opaque bodies, as for instance the comets, which besides the light, that they may have from the sun, seem to shine with a light that is nothing else but an

accension, which they receive from the sun, in their near approaches to it, in their respective revolutions.

The fixt stars are called fixt, because they always keep the same distance one from another.

The sun, at the same distance from us that the fixt stars are, would have the appearance of one of the fixt stars.

CH A P. III.

OF OUR SOLAR SYSTEM.

OUR solar system consists of the sun; and the planets, and comets moving about it.

The planets are bodies, which appear to us like stars; not that they are luminous bodies, that is, have light in themselves; but they shine by reflecting the light of the sun.

They are called planets from a Greek word, which signifies wandering; because they change their places, and do not always

NATURAL PHILOSOPHY. 9.

keep the same distance with one another, nor with the fixt stars, as the fixt stars do.

The planets are either primary or secondary.

There are six primary planets, viz. Mercury, Venus, the Earth, Mars, Jupiter, and Saturn.

All these move round the sun, which is, as it were, the center of their motions.

The secondary planets move round about other planets. Besides the moon, which moves about the earth, four moons move about Jupiter, and five about Saturn, which are called their satellites.

The middle distances of the primary planets from the sun, are as follows:

Mercury	} is distant from the Sun's center about	32,000,000	} statute miles each 5280 English, and 4943 French feet.
Venus		59,000,000	
The Earth		81,000,000	
Mars		123,000,000	
Jupiter		424,000,000	
Saturn		777,000,000	

The orbits of the planets, and their respective distances from the sun, and from one another, together with the orbit of a comet, may be seen in the figure of the solar system hereunto annexed.

The periodical times of each planet's revolution about the sun, are as follows:

		Years.	Days.	Ho.	Min.
Mercury	} Revolves about the Sun in the space of	0	88	0	0
Venus.		0	225	0	0
The Earth		0	365	5	49
Mars		1	322	0	0
Jupiter		11	319	0	0
Saturn		29	138	0	0

The planets move round about the sun from west to east in the zodiac : or, to speak plainer, are always found amongst some of the stars of those constellations, which make the twelve signs of the zodiac.

The motion of the planets about the sun, is not perfectly circular, but rather elliptical.

The reason of their motions in curve lines,

NATURAL PHILOSOPHY. 11

is the attraction of the sun, or their gravitations towards the sun, (call it which you please); and an oblique or side-long impulse or motion.

These two motions or tendencies, the one always endeavouring to carry them in a strait line from the circle they move in, and the other endeavouring to draw them in a strait line to the sun, makes that curve line they revolve in.

The motion of the comets about the sun, is in a very long slender oval; whereof one of the focus's is the center of the sun, and the other very much beyond the sphere of Saturn.

The moon moves about the earth, as the earth doth about the sun. So that it hath the center of its motion in the earth; as the earth hath the center of its revolution in the sun, about which it moves.

The moon makes its synodical motion about the earth, in 29 days, 12 hours, and about 44 minutes.

It is full moon, when the earth being between the sun and the moon, we see all the enlightened part of the moon: new moon, when the moon being between us and the sun, its enlightened part is turned from us: and half moon, when the moon being in the quadratures, as the astronomers call it, we see but half the enlightened part.

An eclipse of the moon is, when the earth, being between the sun and the moon, hinders the light of the sun from falling upon and being reflected by the moon. If the light of the sun is kept off from the whole body of the moon, it is a total eclipse; if from a part only, it is a partial one.

An eclipse of the sun is, when the moon, being between the sun and the earth, hinders the light of the sun from coming to us. If the moon hides from us the whole body of the sun, it is a total eclipse; if not a partial one.

Our solar system is distant from the fixt stars 20,000,000,000 semi-diameters of the

NATURAL PHILOSOPHY. 13

earth: or, as Mr. Huygens expresses this distance, in his *cosmotheoros* §; the fixt stars are so remote from the earth, that, if a canon bullet should come from one of the fixt stars with as swift a motion as it hath when it is shot out of the mouth of a canon; it would be 700,000 years in coming to the earth.

This vast distance so much abates the attraction of those remote bodies, that its operation upon those of our system, is not at all sensible, nor would draw away or hinder the return of any of our solar comets; though some of them should go so far from the sun, as not to make the revolution about it in less than 1000 years.

It is more suitable to the wisdom, power and greatness of God, to think that the fixt stars are all of them suns, with systems of inhabitable planets moving about them, to whose inhabitants He displays the marks of

§. Christiani Hugenii ΚΟΣΜΟΘΕΩΡΟΣ, sive de terris cœlestibus earumque ornatu, conjecturæ, &c. p. m.

24 ELEMENTS OF

his goodness as well as to us ; rather than to imagine that those very remote bodies so little useful to us, were made only for our sake.

C H A P. IV.
OF THE EARTH, CONSIDERED AS A PLANET.

THE earth, by its revolution about the sun in 365 days, 5 hours, 49 minutes, makes that space of time we call a year.

The line, which the center of the earth describes in its annual revolution about the sun, is called the ecliptic.

The annual motion of the earth about the sun, is in the order of the signs of the zodiac; that is, speaking vulgarly, from west to east.

Besides this annual revolution of the earth about the sun, in the ecliptic; the earth turns round upon its own axis in 24 hours,

NATURAL PHILOSOPHY. 15

The turning of the earth upon its own axis every 24 hours, whilst it moves round the sun in a year, we may conceive by the running of a bowl on a bowling-green; in which not only the center of the bowl hath a progressive motion on the green; but the bowl in its going forward, from one part of the green to another, turns round about its own axis.

The turning of the earth on its own axis, makes the difference of day and night; it being day in those parts of the earth, which are turned towards the sun; and night, in those parts which are in the shade, or turned from the sun.

The annual revolution of the earth in the ecliptic, is the cause of the different seasons, and of the several lengths of days and nights, in every part of the world, in the course of the year.

The reason of it, is the earth's going round its own axis in the ecliptic, but at the same time keeping every where its axis e-

qually inclined to the plane of the ecliptic, and parallel to itself. For the plane of the ecliptic inclining to the plane of the equator, 23 degrees and an half, makes that the earth, moving round in the ecliptic, hath sometimes one of its poles, and sometimes the other nearer the sun.

If the diameter of the sun be to the diameter of the earth, as 48 to 1, as by some it is accounted; then the disk of the sun, speaking *numero rotundo*, is above 2000 times bigger than the disk of the earth; and the globe of the sun above 100,000 times bigger than the globe of the earth.

The distance of the earth's orbit from the sun, is above 20,000 semi-diameters of the earth.

If a canon bullet should come from the sun, with the same velocity it hath, when it is shot out of the mouth of a canon it would be 25 years in coming to the earth.

C H A P. V.

OF THE AIR AND ATMOSPHERE.

WE have already considered the earth as a planet, or one of the great masses of matter moving about the sun; we shall now consider it as it is made up of several parts, abstracting from its diurnal and annual motions.

The exterior part of this our habitable world is the air or atmosphere; a light, thin, fluid, or springy body, that encompasses the solid earth on all sides.

The height of the atmosphere above the surface of the solid earth, is not certainly known; but that it doth reach but a very small part of the distance betwixt the earth and the moon, may be concluded from the refraction of the rays coming from the sun, moon, and other luminous bodies.

Though considering that the air we are

in, being near 1000 times lighter than water; and that the higher it is, the less it is compressed by the superior incumbent air, and so consequently being a springy body, the thinner it is; and considering also that a pillar of air of any diameter is equal in weight to a pillar of quicksilver of the same diameter of between 29 and 30 inches height; we may infer that the top of the atmosphere is not very near the surface of the solid earth.

It may be concluded, that the utmost extent of the atmosphere reaches upwards from the surface of the solid earth that we walk on, to a good distance above us: first, if we consider that a column of air of any given diameter is equiponderant to a column of quicksilver of between 29 and 30 inches height. Now quicksilver being near 14 times heavier than water, if air was as heavy as water, the atmosphere would be about 14 times higher than the column of quicksilver, *i. e.* about 34 foot.

NATURAL PHILOSOPHY. 19

Secondly, if we consider, that air is 1000 times lighter than water; then a pillar of air equal in weight to a pillar of quicksilver of 30 inches high will be 6800 foot; whereby we come to know that the air or atmosphere is 6800, *i. e.* near seven miles high.

Thirdly, if we consider that the air is a springy body, and that that which is nearest the earth is compressed by the weight of all the atmosphere that is above it, and rests perpendicularly upon it; we shall find that the air here, near the surface of the earth, is much denser and thicker than it is in the upper parts. For example, if upon a fleece of wool you lay another, the under one will be a little compressed by the weight of that which lies upon it; and so both of them by a third, and so on; so that if 10,000 were piled one upon another, the under one would, by the weight of all the rest, be very much compressed, and all the parts of it be brought abundantly closer together, than when there was no other up-

on it; and the next to that a little less compressed, the third a little less than the second, and so on till it came to the uppermost, which would be in its full expansion, and not compressed at all. Just so it is in the air; the higher you go in it, the less it is compressed, and consequently the less dense it is; and so the upper part being exceedingly thinner than the lower part, which we breathe in; (which is that that is 1000 times lighter than water); the top of the atmosphere is probably much higher than the distance above assigned.

That the air near the surface of the earth will mightily expand itself, when the pressure of the incumbent atmosphere is taken off, may be abundantly seen in the experiments made by Mr. Boyle in his pneumatic engine. In his physico-mechanical experiments concerning the air, he declares * it

* New experiments physico-mechanical, touching the spring of the air, and its effects; (made for the most part in a pneumatical engine) written by the

NATURAL PHILOSOPHY. 21

probable that the atmosphere may be several hundred miles high; which is easy to be admitted, when we consider what he proves in another part of the same treatise, *viz.* that the air here about the surface of the earth, when the pressure is taken from it, will dilate itself above 152 times.

The atmosphere is the scene of the meteors; and therein is collected the matter of rain, hail, snow, thunder, and lightning; and a great many other things observable in the air.

CH A P. VI.

OF METEORS IN GENERAL.

BESIDES the springy particles of pure air, the atmosphere is made up of several steams or minute particles of several sorts, rising from the earth and the waters, and floating in the air, which is a fluid body,

honourable Robert Boyle, Esq; Experiment xxxvi, p. 155. Oxford, 1662. in 4to.

and though much finer and thinner, may be considered in respect of its fluidity to be like water, and so capable, like other liquors, of having heterogeneous particles floating in it.

The most remarkable of them are first, the particles of water raised into the atmosphere, chiefly by the heat of the sun, out of the sea and other waters, and the surface of the earth; from whence it falls in dew, rain, hail and snow.

Out of the vapours rising from moisture, the clouds are principally made.

Clouds do not consist wholly of watry parts; for besides the aqueous vapours that are raised in the air, there are also sulphureous and saline particles, that are raised up, and in the clouds mixed with the aqueous particles, the effects whereof are sometimes very sensible; as particularly in lightning and thunder, when the sulphureous and nitrous particles firing, break out with that violence of light and noise, which

NATURAL PHILOSOPHY. 23

is observable in thunder, and very much resembles gun-powder.

That there are nitrous particles raised into the air, is evident from the nourishment which rain gives to vegetables more than any other water; and also by the collection of niter or salt-peter in heaps of earth, out of which it has been extracted, if they be exposed to the air, so as to be kept from rain; not to mention other efforts wherein the nitrous spirit in the air shews itself.

Clouds are the greatest and most considerable of all the meteors, as furnishing matter and plenty to the earth. They consist of very small drops of water; and are elevated a good distance above the surface of the earth; for a cloud is nothing but a mist flying high in the air, as a mist is nothing but a cloud here below.

How vapours are raised into the air in invisible steams by the heat of the sun out of the sea, and moist parts of the earth, is

easily understood; and there is a visible instance of it in ordinary distillations. But how these steams are collected into drops, which bring back the water again, is not so easy to determine.

To those, that will carefully observe, perhaps it will appear probable, that it is by that, which the chymists call precipitation; to which it answers in all its parts.

The air may be looked on as a clear and pellucid menstruum, in which the insensible particles of dissolved matter float up and down, without being discerned, or troubling the pellucidity of the air; when on a sudden, as if it were by a precipitation, they gather into the very small, but visible misty drops that make clouds.

This may be observed sometimes in a very clear sky; when, there not appearing any cloud, or any thing opaque, in the whole horizon, one may see on a sudden clouds gather, and all the hemisphere overcast; which cannot be from the rising of new a-

NATURAL PHILOSOPHY. 25

aqueous vapours at that time ; but from the precipitation of the moisture that invisible particles floated in the air, into very small, but very visible drops, which by a like cause being united into greater drops, they become too heavy to be sustained in the air ; and so fall down in rain.

Hail seems to be the drops of rain frozen in their falling.

Snow, is the small particles of water frozen before they unite into drops.

The regular figures, which branch out in flakes of snow, seem to shew that there are some particles of salt mixed with the water, which makes them unite in certain angles.

The rain-bow, is reckoned one of the most remarkable meteors, though really it be no meteor at all ; but the reflection of the sun-beams from the smallest drops of a cloud or mist, which are placed in a certain angle made by the concurrence of two lines, the one drawn from the sun, and the

other from the eye to these little drops in the cloud, which reflect the Sun-beams; so that two people looking upon a rain-bow at the same time, do not see exactly the same rain-bow.

CHAP. VII.

OF SPRINGS, RIVERS, AND THE SEA.

PART of the water, that falls down from the clouds, runs away upon the surface of the earth into channels, which convey it to the sea; and part of it is imbibed in the spongy shell of the earth, from whence sinking lower by degrees, it falls down into subterranean channels, and so under ground passes into the sea; or else meeting with beds of rock or clay, it is hindered from sinking lower, and so breaks out in springs, which are most commonly in the sides, or at the bottom of hilly ground.

NATURAL PHILOSOPHY. 27

Springs make little rivulets; those uniting make brooks; and those coming together make rivers, which empty themselves into the sea.

The sea is a great collection of waters in the deep valleys of the earth. If the earth were all plain, and had not those deep hollows, the earth would be all covered with water; because the water, being lighter than the earth, would be above the earth, as the air is above the water.

The most remarkable thing in the sea, is that motion of the water called tides. It is a rising and falling of the water of the sea. The cause of this is the attraction of the moon, whereby the part of the water in the great ocean which is nearest the moon, being most strongly attracted, is raised higher than the rest; and the part opposite to it, on the contrary side, being least attracted, is also higher than the rest. And these two opposite rises of the surface of the water in the great ocean, following the moti-

on of the moon from east to west, and striking against the large coasts of the continents that lie in its way; from thence rebounds back again, and so makes floods and ebbs in narrow seas, and rivers remote from the great ocean. Herein we also see the reason of the times of the tides, and why they so constantly follow the course of the moon.

C H A P. VIII.

OF SEVERAL SORTS OF EARTH, STONES, METALS, MINERALS, AND OTHER FOSSILS.

THIS solid globe we live upon is called the earth, though it contains in it a great variety of bodies, several whereof are not properly earth; which word taken in a more limited sense, signifies such parts of this globe, as are capable, being exposed to the air, to give rooting and nourishment to plants, so that they may stand and grow

NATURAL PHILOSOPHY. 29

in it. With such earth as this, the greatest part of the surface of this globe is covered; and it is as it were the store-house from whence all the living creatures of our world, have originally their provisions; for from thence all the plants have their sustenance, and some few animals, and from these all the other animals.

Of earth, taken in this sense, there are several sorts, v. g. common mould, or garden-earth, clay of several kinds, sandy soils.

Besides these there is medicinal earth; as that which is called Terra Lemnia, Bolus Armenia, and divers others.

After the several earths, we may consider the parts of the surface of this globe, which is barren; and such for the most part are sand, gravel, chalk, and rocks, which produce nothing, where they have no earth mixt among them. Barren sands are of divers kinds; and consist of several little irregular stones without any earth, and of

such there are great desarts to be seen in several parts of the world.

Besides these, which are most remarkable on the surface of the earth, there are found deeper in this globe many other bodies, which, because we discover by digging into the bowels of the earth, are called by one common name Fossils; under which are comprehended metals, minerals or half metals, stones of divers kinds, and fundry bodies that have the texture between earth and stone.

To begin with those fossils which come nearest the earth; under this head we may reckon the several sorts of cker, chalk, that which they call black lead, and other bodies of this kind, which are harder than earth, but have not the consistency and hardness of perfect stone.

Next to these may be considered stones of all sorts; whereof there is almost an infinite variety. Some of the most remarkable either for beauty or use, are these;

NATURAL PHILOSOPHY. 31

marble of all kinds, porphyry, granit, free-stone, &c. flints, agats, cornelians, pebbles, under which kind come the precious stones, which are but pebbles of an excessive hardness, and when they are cut and polished, they have an extraordinary lustre. The most noted and esteemed are, diamonds, rubies, amethysts, emeralds, topazes, opats.

Besides these, we must not omit those, which, though of not so much beauty, yet are of greater use, viz. loadstones, whetstones of all kinds, limestones, calamint or lapis calaminaris; and abundance of others.

Besides these, there are found in the earth several sorts of salts, as eating or common salt, vitriol, salt gemma, and others.

The minerals, or semi-metals, that are dug out of the bowels of the earth, are antimony, cinnaber, zink, &c. to which may be added brimstone.

But the bodies of most use, that are sought for out of the depths of the earth, are the metals; which are distinguished from other

bodies by their weight, fusibility, and malleableness, of which there are these sorts, gold, silver, copper, tin, lead, and, the most valuable of them all, iron; to which one may join that anomalous body, quicksilver or mercury.

He, that desires to be more particularly informed concerning the qualities and properties of these subterraneous bodies, may consult natural historians and chymists.

What lies deeper towards the center of the earth we know not, but a very little beneath the surface of this globe; and whatever we fetch from under ground is only what is lodged in the shell of the earth.

All stones, metals, and minerals, are real vegetables; that is, grow organically from proper seeds, as well as plants.

C H A P. IX.

OF VEGETABLES OR PLANTS.

NEXT to the earth itself, we may consider those that are maintained on its surface; which though they are fastned to it, yet are very distinct from it: and those are the whole tribe of vegetables or plants. These may be divided into three sorts, herbs, shrubs, and trees.

Herbs are those plants, whose stalks are soft, and have nothing woody in them, as grass, fowthistle, and hemlock. Shrubs and trees have all wood in them: but with this difference, that shrubs grow not to the height of trees, and usually spread into branches near the surface of the earth; whereas trees generally shoot up in one great stem or body, and then, at a good distance from the earth, spread into branches: thus, gooseberries, and currants are shrubs; oaks, and cherries, are trees.

In plants the most considerable parts are these, the root; the stalk, the leaves, the flower, and the seed. There are very few of them that have not all these parts, tho' some few there are that have no stalk; others that have no leaves; and others, that have no flowers; but without seed or root I think there are none.

In vegetables, there are two things chiefly to be considered, their nourishment, and propagation.

Their nourishment is thus: the small and tender fibres of the roots, being spread under ground, imbibe from the moist earth juice fit for their nourishment: this is conveyed by the stalk up into the branches, and leaves, through little, and in some plants, imperceptible tubes, and from thence by the bark returns again to the root: so that there is in vegetables, as well as in animals, a circulation of the vital liquor. By what impulse it is moved, is somewhat hard to discover. It seems to be from the differ-

NATURAL PHILOSOPHY. 35

ence of day and night, and other changes in the heat of the air : for the heat dilating, and the cold contracting those little tubes : supposing there be valves in them, it is easy to be conceived how the circulation is performed in plants, where it is not required to be so rapid and quick as in animals.

Nature has provided for the propagation of the species of plants several ways. The first and general is by seed. Besides this, some plants are raised from any part of the root set in the ground: others by new roots, that are propagated from the old ones, as in tulips: others by off-sets; and in others the branches set in the ground, will take root and grow; and last of all grafting and inoculation, in certain sorts, are known ways of propagation. All these ways of increasing plants, make one good part of the skill of gardening; and from the books of gardeners may be best learnt.

THERE is another sort of creatures belonging to this our earth, rather as inhabitants than parts of it. They differ in this from plants, that they are not fixed to any one place, but have a freedom of motion up and down, and besides have sense to guide them in their motions.

Man, and brute, divide all the animals of this our globe.

Brutes may be considered as either aerial, terrestrial, aquatic, or amphibious. I call those aerial, which have wings, where-with they can support themselves in the air. Terrestrial, are those whose only place of rest is upon the earth. Aquatic, are those whose constant abode is upon the water. Those are called amphibious, which live freely in the air upon the earth; and yet are observed to live long upon the water, as if they

NATURAL PHILOSOPHY. 37

were natural inhabitants of that element: though it be worth the examination to know, whether any of those creatures that live at their ease, and by choice, a good while, or at any time upon the earth, can live a long time together perfectly under water.

Aerial animals may be subdivided into birds, and flies,

Fishes, which are the chief part of aquatic animals, may be divided into shell-fishes, scaly-fishes, and those that have neither apparent scales nor shells.

And the terrestrial animals may be divided into quadrupeds or beasts, reptiles, which have many feet, and serpents, which have no feet at all.

Insects, which in their several changes, belong to several of the before mentioned divisions, may be considered together as one great tribe of animals. They are called insects from a separation in the middle of their bodies, whereby they are, as it were, cut into two parts, which are joined together

by a small ligature : as we see in wasps, common flies, and the like.

Besides all these, there are some animals that are not perfectly of these kinds, but placed, as it were, in the middle betwixt two of them, by something of both; as bats, which have something of beasts, and birds in them.

Some reptiles of the earth, and some of the aquatics, want one or more of the senses, which are in perfecter animals; as worms, oysters, cockles, &c.

Animals are nourished by food, taken in at the mouth, digested in the stomach, and thence, by fit vessels, distributed over the whole body, as is described in books of anatomy.

The greatest part of animals have five senses, viz. seeing, hearing, smelling, tasting, and feeling. These, and the way of nourishment of animals, we shall not particularly consider; because they are common to man with beasts.

NATURAL PHILOSOPHY. 39

The way of nourishment of animals, particularly of man, is by food taken in at the mouth, which being chewed there, is broken and mixed with the saliva, and thereby prepared for an easier and better digestion in the stomach.

When the stomach has performed its office upon the food, it protrudes it into the guts, by whose peristaltic motion it is gently conveyed along through the guts; and as it passes, the chyle, which is the nutritive part, is separated from the excrementitious by the lacteal veins; and from thence conveyed into the blood, with which it circulates till itself be concocted into blood. The blood being by the vena cava brought into the right ventricle of the heart, by the contraction of that muscle, is driven thro' the arteria pulmonaris into the lungs; where the constantly-inspired air mixing with it, enlivens it; and from thence being conveyed by the vena pulmonaris into the left ventricle of the heart, the contraction of the

heart forces it out, and by the arteries distributes it into all parts of the body; from whence it returns by the veins into the right ventricle of the heart to take the same course again. This is called the circulation of the blood; by which life and heat are communicated to every part of the body.

In the circulation of the blood, a good part of it goes up into the head, and by the brains are separated from it, or made out of it the animal spirits, which, by the nerves, impart sense and motion to all parts of the body.

The instruments of motion are the muscles, the fibres whereof contracting themselves, move the several parts of the body.

This contraction of the muscles is in some of them by the direction of the mind, and in some of them without it; which is the difference between voluntary, and involuntary motions, in the body.

CHAP. IX.
OF THE FIVE SENSES.

OF SEEING.

THE organ of seeing is the eye : consisting of variety of parts wonderfully contrived, for the admitting and refracting the rays of light ; so that those that come from the same point of the object, and fall upon different parts of the pupil, are brought to meet again at the bottom of the eye, whereby the whole object is painted on the retina that is spread there.

That, which immediately affects the sight, and produces in us that sensation, which we call seeing, is light.

Light may be considered either, first, as it radiates from luminous bodies directly to our eyes ; and thus we see luminous bodies themselves, as the sun, or a flame, &c. or, secondly, as it is reflected from other bo-

dies; and thus we see a man, or a picture by the rays of light reflected from them to our eyes.

Bodies, in respect of light, may be divided into three sorts: first, those that emit rays of light, as the sun and fixt stars: secondly those that transmit the rays of light, as the air; thirdly, those that reflect the rays of light, as iron, earth, &c. the first are called luminous; the second pellucid; and the third opaque.

The rays of light themselves are not seen: but by them, the bodies, from which they originally come; as the sun, or a fixt star: or the bodies, from which they are reflected; as a horse, or a tulip. When the moon shines, we do not see the rays which come from the sun to the moon; but by them, we see the moon from whence they are reflected.

If the eye be placed in the medium thro' which the rays pass to it, the medium is not seen at all: for instance, we do not see the

NATURAL PHILOSOPHY. 43

air through which the rays come to our eyes. But if a pellucid body, thro' which the light comes, be at a distance from our eye, we see that body, as well as the bodies from whence the rays come, that pass thro' them to come to our eyes. For instance, we do not only see bodies through a pair of spectacles, but we see the glass itself. The reason whereof is, that pellucid bodies, being bodies, the surfaces of which reflect some rays of light from their solid parts; these surfaces, placed at a convenient distance from the eye, may be seen by those reflected rays: as, at the same time, other bodies beyond those pellucid ones may be seen by the transmitted rays.

Opaque bodies are of two sorts, specular, or not specular. Specular bodies, or mirrors, are such opaque bodies whose surfaces are polished; whereby they reflecting the rays in the same order as they come from other bodies, shew us their images.

The rays that are reflected from opaque

bodies, always bring with them to the eye the idea of colour; and this colour is nothing else in the bodies, but a disposition to reflect to the eye more copiously one sort of rays, than another. For particular rays are originally endowed with particular colours; some are red, others blue, others yellow, and others green, &c.

Every ray of light, as it comes from the sun, seems a bundle of all these several sorts of rays: and as some of them are more refrangible than others; that is, are more turned out of their course, in passing from one medium to another; it follows, that after such refraction they will be separated, and their distinct colour observed. Of these, the most refrangible are violet, and the least red; and the intermediate ones, in order, are indigo, blue, green, yellow and orange. This separation is very entertaining, and will be observed with pleasure in holding a prism in the beams of the sun.

As all these rays differ in refrangibility,

NATURAL PHILOSOPHY. 45

so they do in reflexivity, that is, the property of being more easily reflected from certain bodies, than from others: and hence arise, as hath been said, all the colours of bodies, which are in a manner infinite, as an infinite number of compositions, and proportions of the original colours, may be imagined.

The whiteness of the sun's light, is compounded of all the original colours mixed in a due proportion.

Whiteness, in bodies, is but a disposition to reflect all colours of light, nearly in the proportion they are mixt in the original rays: as, on the contrary, blackness, is only a disposition to absorb or stifle, without reflection, most of the rays of every sort that fall on the bodies.

Light is successively propagated, with an almost inconceivable swiftness: for it comes from the sun to this our earth in about seven or eight minutes of time, which distance is about 70,000,000 English miles.

Besides colour, we are supposed to see figure; but in truth, that which we perceive when we see figure, as perceivable by sight, is nothing but the termination of colour.

OF HEARING.

NEXT to seeing, hearing is the most extensive of our senses. The ear is the organ of hearing, whose curious structure is to be learnt from anatomy.

That, which is conveyed into the brain by the ear, is called sound: tho' in truth, till it come to reach and affect the perceptive part, it be nothing but motion.

The motion, which produces in us the perception of sound, is a vibration of the air, caused by an exceeding short, but quick, tremulous motion of the body, from which it is propagated; and therefore we consider and denominate them as bodies sounding.

NATURAL PHILOSOPHY. 47

That sound is the effect of such a short, brisk, vibrating motion of bodies, from which it is propagated; may be known from what is observed and felt in the strings of instruments, and the trembling of bells, as long as we perceive any sound come from them; for as soon as that vibration is stopt, or ceases in them, the perception ceases also.

The propagation of sound is very quick, but not approaching that of light. Sounds move about 1140 English feet, in a second minute of time; and in seven or eight minutes of them, they move about one hundred English miles.

OF SMELLING.

SMELLING, is another sense, that seems to be wrought on by bodies at a distance; tho' that which immediately affects the organ, and produces in us the sensation of any smell, are effluvia's, or invisible particles, that, coming from bodies at a distance,

immediately affect the olfactory nerves.

Smelling bodies seem perpetually to send forth effluvia's or steams, without sensibly wasting at all. Thus a grain of musk will send forth odoriferous particles for scores of years together, without its being spent: whereby one would conclude that these particles are very small: and yet it is plain, that they are much grosser than the rays of light, which have a free passage thro' glass; and grosser also than the magnetick effluvia's, which pass freely thro' all bodies, when those that produce smell, will not pass the thin membranes of a bladder, and many of them scarce ordinary white paper.

There is a great variety of smells, tho' we have but a few names for them: sweet, stinking, sower, rank, and musty, are almost all the denominations we have for odours; tho' the smell of a violet, and of musk, both called sweet, are as distinct as any two smells whatsoever.

OF TASTE.

TASTE, is the next sense to be considered.

The organ of taste, is the tongue and palate.

Bodies that emit light, sounds and smells, are seen, heard, and smelt at a distance: but bodies are not tasted, but by immediate application to the organ; for till our meat touch our tongues or palates, we taste it not, how near soever it be.

It may be observed of taste, that though there be a great variety of them, yet, as in smells, they have only some few general names, as sweet, bitter, sower, harsh, rank, and some few others.

OF TOUCH.

THE fifth and last of our senses is touch ; a sense spread over the whole body, though it be most eminently placed in the ends of the fingers.

By this sense the tangible qualities of bodies are discerned ; as hard, soft, smooth, rough, dry, wet, clammy, and the like.

But the most considerable of the qualities, that are perceived by this sense, are heat, and cold.

The due temperament of those two opposite qualities, is the great instrument of nature, that she makes use of, in most, if not all her productions.

Heat, is a very brisk agitation of the insensible parts of the object, which produces in us that sensation, from whence we denominate the object hot ; so what in our sensation is heat ; in the object is nothing but motion. This appears by the way where-

NATURAL PHILOSOPHY. 51

by heat is produced, for we see that the rubbing of a brass nail upon a board, will make it very hot; and the axle-trees of carts or coaches are often hot, and sometimes to a degree, that it sets them on fire, by the rubbing of the wheel upon it.

On the other side, the utmost degree of cold is the cessation of that motion of the insensible particles, which to our touch is heat.

Bodies are denominated hot and cold in proportion to the present temperament of that part of our body, to which they are applied; so, that feels hot to one, which seems cold to another; because the motion of the insensible particles of it, may be more brisk than that of the particles of the other.

Besides the objects before-mentioned, which are peculiar to each of our senses, as light, and colour of the sight; sound of hearing; odours of smelling; flavours of tasting; and tangible qualities of the touch;

there are two others that are common to all the senses; and those are pleasure and pain, which they may receive by and with their peculiar objects. Thus too much light offends the eye; some sounds delight, and others grate the ear; heat in a certain degree is very pleasant, which may be augmented to the greatest torment: and so of the rest.

These five senses are common to beasts with men; nay in some of them, some brutes exceed mankind. But men are endowed with other faculties, which far excel any thing that is to be found in the other animals, in this our globe.

Memory also, brutes may be supposed to have, as well as men.

CHAP. XII. OF THE UNDERSTANDING OF MAN.

THE understanding of man does so surpass that of brutes, that some are

NATURAL PHILOSOPHY. 53

of opinion, brutes are mere machines, without any manner of perception at all. But letting this opinion alone, as ill grounded, we will proceed to the consideration of human understanding, and the distinct operations thereof.

The lowest degree of it consists in perception, which we have before in part taken notice of, in our discourse of the senses. Concerning which it may be convenient farther to observe, that to conceive a right notion of perception, we must consider the distinct objects of it, which are simple ideas, v. g. such as are those signified by these words, scarlet, blue, sweet, bitter, heat, cold, &c. From the other objects of our senses; to which we may add the internal operations of our own minds, as the objects of our own reflection, such as are thinking, willing, &c.

Out of these simple ideas are made, by putting them together, several compound-

ed, or complex ideas; as these signified by the word pebble, marygold, horse.

The next thing the understanding doth in its progress to knowlege, is to abstract its ideas, by which abstraction they are made general.

A general idea, is an idea in the mind, considered there as separated from time and place; and so capable to represent any particular being that is conformable to it. Knowlege, which is the highest degree of the speculative faculties, consists in the perception of the truth of affirmative, or negative propositions.

This perception is either immediate or mediate. Immediate perception of the agreement or disagreement of two ideas, is when by comparing them together in our minds, we see, or as it were behold, their agreement or disagreement. This therefore is called intuitive knowlege. Thus we see that red is not green; that the whole is bigger than a part; that two and two are equal to four.

NATURAL PHILOSOPHY. 55

The truth of these, and the like propositions, we know by a bare simple intuition of the ideas themselves, without any more ado: and such propositions are called self-evident.

The mediate perception of the agreement or disagreement of two ideas, is when, by the intervention of one or more other ideas, their agreement or disagreement is shewn. This is called demonstration, or rational knowlege. For instance, the inequality of the breadth of two windows, or two rivers, or any two bodies that cannot be put together, may be known by the intervention of the same measure, applied to them both; and so it is in our general ideas, whose agreement or disagreement may be often shewn by the intervention of some other ideas, so as to produce demonstrative knowlege; where the ideas in question cannot be brought together, and immediately compared, so as to produce intuitive knowlege.

The understanding doth not know only certain truth; but also judges of probability, which consists in the likely agreement or disagreement of ideas.

The assenting to any proposition as probable, is called opinion, or belief.

We have hitherto considered the great and visible parts of the universe, and those great masses of matter, the stars, planets, and particularly this our earth, together with the inanimate parts, and animate inhabitants of it; it may be now fit to consider what these sensible bodies are made of, and that is, of unconceivable small bodies, or atoms, out of whose various combinations bigger molleculæ are made; and so by a greater and greater composition bigger bodies; and out of these the whole material world is constituted.

By the figure, bulk, texture, and motion, of these small and insensible corpuscles, all the phænomena of bodies may be explained.

F I N I S.

SOME THOUGHTS;
CONCERNING;

READING AND STUDY
FOR A

GENTLEMAN.

READING is for the improvement
of the understanding.

The improvement of the understanding,
is for two ends; first, for our own increase
of knowlege; secondly, to enable us to de-
liver and make out that knowlege to others.

The latter of these, if it be not the chief
end of study in a gentleman; yet it is at
least equal to the other, since the greatest
part of his business and usefulness in the
world, is by the influence of what he says,
or writes to others.

The extent of our knowlege, cannot exceed the extent of our ideas. Therefore he, who would be universally knowing, must acquaint himself with the objects of all sciences. But this is not necessary to a gentleman, whose proper calling is the service of his country; and so is most properly concerned in moral and political knowlege: and thus the studies which more immediately belong to his calling, are those which treat of virtues and vices, of civil society, and the arts of government; and will take in also law and history.

It is enough for a gentleman to be furnished with the ideas belonging to his calling, which he will find in the books that treat of the matters above-mentioned.

But the next step towards the improvement of his understanding, must be to observe the connection of these ideas in the propositions, which those books hold forth, and pretend to teach as truths; which till a man can judge, whether they be truths

CONCERNING READING: 59

or no, his understanding is but little improved; and he doth but think and talk after the books that he hath read, without having any knowlege thereby. And thus, men of much reading, are greatly learned; but may be little knowing.

The third and last step therefore, in improving the understanding, is to find out upon what foundation any proposition, advanced, bottoms; and to observe the connection of the intermediate ideas by which it is joined to that foundation, upon which it is erected, or that principle from which it is derived. This, in short, is right reasoning; and by this way alone, true knowlege is to be got by reading, and studying.

When a man, by use, hath got this faculty of observing and judging of the reasoning and coherence of what he reads, and how it proves what it pretends to teach; he is then, and not till then, in the right way of improving his understanding, and enlarging his knowlege by reading.

But that, as I have said, being not all that a gentleman should aim at in reading, he should farther take care to improve himself in the art also of speaking; that so he may be able to make the best use of what he knows.

The art of speaking well, consists chiefly in two things, viz. perspicuity and right reasoning.

Perspicuity, consists in the using of proper terms for the ideas or thoughts, which he would have pass from his own mind into that of another man's. It is this, that gives them an easy entrance; and it is with delight, that men hearken to those whom they easily understand: whereas what is obscurely said, dying as it is spoken, is usually not only lost, but creates a prejudice in the hearer, as if he that spoke knew not what he said, or was afraid to have it understood.

The way to obtain this, is to read such books as are allowed to be writ with the greatest clearness and propriety, in the lan-

CONCERNING READING. 61

guage that a man uses. An author excellent in this faculty, as well as several others, is Dr. Tillotson, late archbishop of Canterbury, in all that is published of his. I have chose rather to propose this pattern, for the attainment of the art of speaking clearly, than those who give rules about it: since we are more apt to learn by example, than by direction. But if any one hath a mind to consult the masters in the art of speaking and writing, he may find in Tully de oratore, and another treatise of his called, Orator; and in Quintilian's Institutions; and Boileau's *Traite du sublime* *; instructions concerning this, and the other parts of speaking well.

Besides perspicuity, there must be also right reasoning; without which perspicuity serves but to expose the speaker: and for the attaining of this, I should propose the constant reading of Chillingworth, who by his example will teach both reason and per-

* That treatise is a translation from Longinus.

spicuity, and the way of right reasoning, better than any book that I know; and therefore will deserve to be read upon that account over and over again; not to say any thing of his argument.

Besides these books in English, Tully, Terence, Virgil, Livy and Cæsar's Commentaries, may be read to form one's mind to a relish of a right way of speaking and writing.

The books I have hitherto mentioned, have been in order only to writing, and speaking well; not but that they deserve to be read upon other accounts.

The study of morality, I have above mentioned as that, that becomes a gentleman; not barely as a man, but in order to his business as a gentleman. Of this there are books enough writ both by antient and modern philosophers; but the morality of the Gospel doth so exceed them all, that to give a man a full knowlege of true morality, I should send him to no other book, but the new testament. But if he hath a mind to see how far the hea-

CONCERNING READING. 63

then world carried that science, and where-
on they bottomed their ethics, he will be de-
lightfully and profitably entertained in Tul-
ly's treatises de officiis.

Politics, contains two parts, very different
the one from the other. The one contain-
ing the original of societies, and the rise
and extent of political power; the other,
the art of governing men in society.

The first of these hath been so bandied
amongst us, for these sixty years backward,
that one can hardly miss books of this kind.
Those which I think are most talked of in
English, are the first book of Mr. Hooker's
Ecclesiastical polity, and Mr. Algernoon Sid-
ney's discourses on government. The lat-
ter of these I never read. Let me here
add, two treatises of government, printed in
1690 †: and a treatise of civil polity, prin-
ted this year *. To these one may add,

† These two treatises are written by Mr. Locke him-
self.

* Civil Polity, A treatise concerning the nature of

Puffendorf *De officio hominis et civis*; and, *De jure naturali et gentium*; which last is the best book of that kind.

As to the other part of politics, which concerns the art of government; that, I think, is best to be learned by experience and history, especially that of a man's own country. And therefore I think an English gentleman ought to be well versed in the history of England, taking its rise as far back as there are any records of it; joining with it the laws that were made in the several ages, as he goes along in his history; that he may observe from thence the several turns of state, and how they have been produced. In Mr. Tyrrel's history of England, he will find all along those several authors, which have treated of our affairs, and which he may have recourse to, concerning any point which either his curiosity or judgment shall lead him to enquire into.

government, &c. London 1703, in 8vo. written by Peter Paxton, M. D.

CONCERNING READING. 65

With the history, he may also do well to read the ancient lawyers; such as Bracton, Fleta, Henningham, Mirrour of justice, my Lord Cook's second institutes, and the Modus tenendi parliamentum; and others of that kind, which he may find quoted in the late controversies, between Mr. Petit, Mr. Tyrrel, Mr. Atwood, &c. with Dr. Brady; as also, I suppose, in Sedler's treatise of rights of the kingdom, and customs of our ancestors, whereof the first edition is the best; wherein he will find the ancient constitution of the government of England.

There are two volumes of state tracts, printed since the revolution, in which there are many things relating to the government of England *.

* We have now two collections of state tracts; one, in two volumes in folio, printed in 1689 and 1692, contains several treatises relating to the government, from the year 1660 to 1689; and the other, in three volumes in folio, printed in 1705, 1706, and 1707, is a collection of tracts, published on occasion of the late Revolution

As for general history, Sir Walter Raleigh, and Dr. Howel, are books to be had. He, who hath a mind to launch farther into that ocean, may consult Whear's *Methodus legendi historias*, of the last edition; which will direct him to the authors he is to read, and the method wherein he is to read them.

To the reading of history; chronology, and geography, are absolutely necessary.

In geography, we have two general ones in English, Heylyn and Moll: which is the best of them, I know not; having not been much conversant in either of them. But the last, I should think to be of most use: because of the new discoveries that are made every day, tending to the perfection of that science. Tho', I believe, that the countries which Heylyn mentions, are better treated

in 1698, and during the reign of K. William III. These collections might have been made more complete and more convenient; especially the first, which is extremely defective and uncorrect.

CONCERNING READING. 67

of by him, bating what new discoveries since his time have been added.

These two books contain geography in general; but whether an English gentleman would think it worth his time to bestow much pains upon that; tho' without it he cannot well understand a gazette; it is certain he cannot well be without Cambden's Britannia, which is much enlarged in the last English edition. A good collection of maps is also necessary.

To geography, books of travels may be added. In that kind, the collections made by our country-men Hakluyt, and Purchas, are very good. There is also a very good collection made by Thevenot in folio, in French; and by Ramuzio, in Italian; whether translated into English or no, I know not. There are also several good books of travels of English-men published, as Sandys, Roe, Brown, Gage, and Dampier.

There are also several voyages in French,

which are very good, as Pyrard *, Bergeron †, Sagard §, Bernier *, &c. whether all of them are translated into English, I know not.

There is at present a very good collection of voyages and travels, never before in English, and such as are out of print; now printing by Mr. Churchill †.

There are besides these, a vast number of other travels; a sort of books that have a very good mixture of delight and usefulness. To set them down all, would take up too much time and room. Those I have mentioned are enough to begin with.

As to chronology, I think Helvicus the best for common use; which is not a book

* Voyage de Francois Pyrard de Laval. contenant sa navigation aux Indes Orientales, Maldives, Moluques, Bresil. Paris 1619, 8vo. 3d edit.

† Relation des voyages en Tartarie, &c. le tout recueilli par Pierre Bergeron. Paris 1634, 8vo.

§ Le grand voyage des Hurons, situés en l' Amerique, &c. par F. Gab. Sagard Theodat. Paris 1632, 8vo.

* Memoirs de l' Empire du Grand Mogol, &c. par Francois Bernier. Paris 1670, & 1671, 3 vol. in 12.

† That collection of voyages and travels was published anno 1704, in 4 vol. in folio.

CONCERNING READING. 69

to be read, but to lye by, and be consulted upon occasion. He, that hath a mind to look farther into chronology, may get Tallet's Tables, and Strauchius's Breviarium Temporum: and may to those add Scaliger De Emendatione Temporum, and Petavius; if he hath a mind to engage deeper in that study.

Those who are accounted to have writ best particular parts of our English history, are Bacon, of Henry VII; and Herbert, of Henry VIII. Daniel also is commended; and Burnet's history of the reformation.

Mariana's history of Spain, and Thuanus his history of his own time, and Philip de Comines; are of great and deserved reputation.

There are also several French and English memoirs and collections, such as La Rochefaucault, Melvil, Rushworth, &c. which give a great light to those, who have a mind to look into what hath past in Europe this last age.

To fit a gentleman for the conduct of himself, whether as a private man, or as interested in the government of his country, nothing can be more necessary than the knowledge of men: which, tho' it be to be had chiefly from experience, and next to that, from a judicious reading of history; yet there are books that of purpose treat of human nature, which help to give an insight into it. Such are those treating of the passions, and how they are moved; whereof Aristotle in his second book of rhetoric hath admirably discoursed, and that in a little compass. I think this rhetoric is translated into English: if not, it may be had in Greek and Latin together.

La Bruyere's characters are also an admirable piece of painting: I think it is also translated out of French into English.

Satyrical writings also, such as Juvenal, and Persius, and above all Horace; tho' they paint the deformities of men, yet thereby they teach us to know them.

CONCERNING READING. 71

There is another use of reading, which is for diversion, and delight. Such are poetical writings, especially dramatic, if they be free from prophaneness, obscenity and what corrupts good manners: for such pitch should not be handled.

Of all books of fiction, I know none that equals Chervantes's history of Don Quixot in usefulness, pleasantry, and a constant decorum. And indeed no writings can be pleasant which have not nature at the bottom, and are not drawn after her copy.

There is another sort of books, which I had almost forgot, with which a gentleman's study ought to be well furnished, viz. Dictionaries of all kinds. For the Latin tongue, Littleton, Cooper, Calepin, and Robert Stephen's *Thesaurus Linguae Latinae*, and Vossi *Etymologicum Linguae Latinae*. Skinner's *Lexicon Etymologicum* is an excellent one of that kind for the English tongue. Cowel's *Interpreter*, is useful for the law terms. Spelman's *Glossary*, is a ve-

very useful and learned book. And Seldon's Titles of Honour, a gentleman should not be without. Baurand hath a very good Geographical Dictionary. And there are several historical ones, which are of use; as Lloyd's, Hoffman's, Moreri's. And Bayle's incomparable dictionary is something of the same kind. He that hath occasion to look into books written in Latin since the decay of the Roman empire, and the purity of the Latin tongue, cannot be well without Ducange's *Glossarium Mediæ et Infimæ Latinitatis*.

Among the books above set down, I mentioned Vossius's *Etymologicum Linguae Latinae*: all his works are lately printed in Holland in six tomes. They are very fit books for a gentleman's Library, as containing very learned discourses concerning all the Sciences.

F I N I S.